NOTES ON METEOROLOGY AND CLIMATOLOGY

PHYSIOLOGICAL METEOROLOGY

IN opening his presidential address[1] before the American Meteorological Society at Chicago in December, Professor Robert DeC. Ward directed attention to the fact that the Constitution of the Society states as its first object "the advancement and diffusion of knowledge of meteorology, including climatology, and the development of its application to public health . . . ." He said further that, in spite of the intimate relations existing between meteorology and health, there are few physicians who have even an elementary training in meteorology, and perhaps fewer meteorologists who are competent to deal with the physiological and medical relations. It appears, however, that more and more thought is being given the subject, both at home and abroad; and this interest is finding its expression in various researches and numerous papers, these, in turn, being applied practically in the control of air conditions in hospitals,[2] factories,[3] and, in fact, in many other places where human health and mechanical efficiency must be maintained at their best.

Numerous papers bearing upon the subject of physiological meteorology have been published from time to time in the *Monthly Weather Review,* and among the most important of these is one by Dr. Leonard Hill of Essex, England, on "Atmospheric environment and health."[4] Says Dr. Hill:

> The body is fashioned by nature for the getting of food by active exercise, and upon the taking of such exercise depends the proper vigorous function of the digestive, respiratory and vascular organs. Consequent on this, too, is the vigor of the nervous system and keen enjoyment of life. So, too, the healthy state of joints, muscles and ligaments, and freedom from rheumatic pains depend upon proper exercise of the body, neither over use nor under use, either of which may be associated with malnutrition and lowered resistance to infection. The hothouse conditions of life suitable for the failing powers of the aged, the injured in a state of shock and those in the last stages of wasting disease are mistakenly supposed to be suitable for the young and healthy. The traditional fear of cold is handed down from mother to children at her knee. For fear of their "catching cold," they are confined indoors and overclothed. They are debilitated and exposed at the same time to massive infection in crowded places. They require well-chosen food containing all those vitamines or principles of growth which are found in milk, the young green shoots of plants, grain foods with the germ and outer layers not removed by the miller. At the same time they require the stimulation of abundant open-air exercise to make them eat and metabolize their food. Household expenses will go up as more food is eaten by children excited by open-air exercise to keen appetite, but an immense national economy will result from a healthy, vigorous, efficient people.

But to obtain quantitative measures of the meteorological conditions most closely related to bodily comfort and health (these conditions being temperature, vapor-pressure, and velocity of air movement), recourse must be had to other devices than the familiar wet- and dry-bulb thermometers. The thermometer, Dr. Hill points out, is a static instrument, while the body is dynamic, since heat is produced at a certain rate and must be lost at an equal rate. To meet this need, Dr. Hill, in 1913, devised the *katathermometer,* which has given excellent results. The katathermometer[5] consists of "a large-bulbed spirit thermometer of standard size and shape, graduated between 100° F. and 95° F. The

[1] "Climate and Health, with Special Reference to the United States." Author's abstract in *Monthly Weather Review,* December, 1920, pp. 690–691. Published in *The Scientific Monthly,* April, 1921.

[2] See Huntington, Ellsworth, "The Importance of Air Control in Hospitals," *The Modern Hospital,* April and May, 1920, pp. 271–275 and 348–353; noted in *Monthly Weather Review,* May, 1920, pp. 279–280.

[3] Mount, Harry A., "Making Weather to Order," *Scientific American,* March 5, 1921, pp. 188 and 198.

[4] December, 1920, pp. 687–690.

[5] *Cf.* Jacob, Robert A., "The Katathermometer: An Instrument to Measure Bodily Comfort," *Monthly Weather Review,* September, 1920, pp. 497–498, for history, description and photographs of the katathermometer.

bulb is heated in hot water in a thermos flask until the meniscus rises into the small top of the bulb. It is then dried, suspended and the time of cooling from 100° to 95° F. taken with a stop watch in seconds. The number of seconds, divided into a factor number (approximately 500, and determined for each instrument) gives the cooling power by convection and radiation on the surface of the "kata" at approximately skin temperature in millicalories per square centimeter per second. The operation is repeated with a cotton muslin finger stall on the bulb and the wet "kata" cooling power obtained, a cooling power due to evaporation, radiation and convection. The difference between the two readings gives the cooling power of the evaporation alone.

It is shown by a table to what low values the cooling power can fall in stagnant air at even moderate temperatures—values that are much too low for any except the most sedentary occupations. And yet it is true that in many factories and mills where great heat is generated by rapidly moving machinery, or where workmen are subjected to high temperatures in engine rooms and about furnaces, no provision is made for the introduction of cool air, nor even for keeping the warm air in circulation. The result is that the proper vigorous activity of the respiratory and vascular organs is not maintained and illness, or general depression, with its consequent inefficiency results. An excellent example of the effect of providing proper means for cooling is that of a large steel tube factory in England, where air ducts supply air so cool that the men working before the huge furnaces actually feel cool when the furnace doors are shut. The effect is quite like the heating and cooling on a summer's day with passing clouds. It is said that the output of that factory is greater than that of any other of its kind, and there is no industrial unrest. Thus it is, that by reproducing as far as possible within doors the slight variations of temperature and air movement which outdoor workers experience, it is possible to make some progress in keeping the sedentary worker in the same robust and vigorous physical condition in which the outdoor worker finds himself. The economic importance of giving attention to these considerations is obvious.

A study of the relations between weather conditions and the incidence of certain diseases in north Atlantic states has been made by Mr. John R. Weeks, U. S. Weather Bureau meteorologist at Binghamton, N. Y.[6] From his studies he has drawn the following conclusions:

First, that a moderate degree of humidity, about 70 per cent., and a moderate temperature, about 68° F., should be maintained in dwellings;

Second, that crowding and mingling with persons having cough should be avoided;

Third, that sunshine and plenty of interior light should be sought; and

Fourth, that schools for janitors should be provided in order that the heating and ventilation of public places may be properly cared for.

The objection that a relative humidity as high as 70 per cent. indoors in winter would be difficult to maintain with a temperature as high as 68° F. is, no doubt, a valid one; but such a temperature would probably be too high for comfort with that humidity. Since it would be much easier to maintain a high humidity with a lower temperature it probably would be possible to find a practicable combination of temperature and humidity which would be entirely comfortable. In an article by William E. Watt, principal of the Graham Public School, Chicago, on "How I run my school,"[7] it is found that a temperature of 60° F. is sufficiently high for comfort if sufficient humidity is maintained. By introducing live steam into his warm air ducts he found it possible to maintain such conditions, with beneficial results to teachers and pupils.

In addition to the necessity for local con-

[6] Abstract and discussion in *Bulletin of the American Meteorological Society*, February, 1921, pp. 27–28.

[7] *The Ladies' Home Journal*, September 1, 1910, p. 20.

siderations of atmospheric conditions and health, there are the broader and more general aspects of climate and the treatment of certain diseases. Professor Ward, in the address earlier referred to, emphasized the correct understanding of the characteristics of climate and the judicious selection of climates to suit the particular ailments, for there is no "perfect" climate that will be equally beneficial for all ills.

Efforts have been made frequently to give graphical representations of climatic characteristics, especially with regard to temperature and humidity, and some of these have been very successful. Perhaps the *climograph* of Dr. Griffith Taylor, of Australia, is the most noteworthy example. Mr. B. M. Varney[8] says:

> One scarcely need point out the great usefulness, to the geographer, the business man, the physician, the teacher, any device which helps to create living conceptions of the nature of climate and weather, so leading to a better estimate of the effect of a given atmospheric environment on human affairs.

That is what the climograph seeks to do. It is a chart in which wet-bulb temperatures are plotted against relative humidity, or air temperature (dry-bulb) against relative humidity. Mr. Varney has chosen to mark certain regions of his climographs "raw," "keen," "scorching," "muggy," etc., to indicate bodily sensation. The line joining the points in the diagram wanders about among these regions and thus indicates the characteristics of the weather or climate under consideration.

Dr. Carrol E. Edson, president of the American Climatological and Clinical Association, at the meeting of the Meteorological Society mentioned above, gave the following questions as being worthy of study by the meteorologist, and referred to them as gaps in present medical knowledge:

1. Is basic metabolism different in people living at high altitudes from that of people living at low altitudes? A study of this might be called "Climatic physiology."

2. What is the effect of sudden changes—changes of altitude, temperature, moisture, wind, etc.? Experimental solution of this question is possible. This is "Physiologic meteorology."

3. Lastly, there is the study of the adaptability of the diseased mechanism to meet sudden changes: "Medical climatology."

These are a few of the aspects of the relations between meteorology and health, and indicate what an extensive field there is for investigation, both for the meteorologist and the physician.

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[8] "Some Further Uses of the Climograph," *Monthly Weather Review*, September, 1920, pp. 495–497.

SPECIAL ARTICLES

A NEW TYPE OF INHERITANCE

IN a recent contribution from the Carlsberg Laboratory,[1] J. Schmidt has described a new type of inheritance found in "the millions fish," *Lebistes reticulatus*, from Trinidad. A conspicuous black spot occurs on the dorsal fin of the male in one race of this species, but it is wanting in all females of the species and also in males of a second race with which crosses were made. This spot was transmitted to all male offspring of the spotted fish, regardless of the mother's ancestry, but it was not found in the female offspring, nor did it reappear in the male offspring of such females, when they were mated with males which lacked the spot.

Further, sons of the spotted male, transmitted the spot to *all* their male offspring, not to half of them, as would be the case with an ordinary dominant Mendelian character. The inheritance of the character appears to be exclusively from father to son, females neither possessing nor transmitting it. Evidently the sperm is the sole vehicle of its transmission. It does not get into the egg at all. Moreover it is apparently transmitted by only *half* the sperm cells, those namely which are male determining in function. It therefore has, as Schmidt points out, exactly the distribution of a Y chromosome, and he suggests that a Y

[1] *C. R. Travaux Laboratoire Carlsberg*, Vol. 14, No. 8, Copenhagen, 1920.